WHAT IS CLAIMED IS:

1. A process for producing a thin film semiconductor device comprising

a film forming step of forming a semiconductor thin film comprising an amorphous material or a polycrystalline material having a relatively small particle diameter on a substrate;

an irradiation step of irradiating said semiconductor thin film with an energy beam to convert said amorphous material or said polycrystalline material having a relatively small particle diameter to a polycrystalline material having a relatively large particle diameter; and

a forming step of integrating and forming a thin film transistor in a prescribed region by using said semiconductor thin film thus converted to said polycrystalline material as an active layer,

wherein said irradiation step comprises irradiating said region once or more with said energy beam, to which a desired change in time and space is applied, and

in said film forming step, said irradiation step and transportation therebetween, said substrate is not exposed to the air.

2. A process for producing a thin film semiconductor device comprising

~~a film forming step of forming a semiconductor thin film comprising an amorphous material or a polycrystalline material having a relatively small particle diameter on a substrate;~~

~~an irradiation step of irradiating said semiconductor thin film with an energy beam having an emission time width from upstand to downfall of 50 ns or more to convert said amorphous material or said polycrystalline material having a relatively small particle diameter to a polycrystalline material having a relatively large particle diameter; and~~

~~a forming step of integrating and forming a thin film transistor in a prescribed region by using said semiconductor thin film thus converted to said polycrystalline material as an active layer,~~

~~wherein said irradiation step comprises irradiating said region once or more with said energy beam, a cross sectional shape of which is changed and adjusted to said region, with an intensity of said energy beam from upstand to downfall being controlled to apply a desired change, and~~

~~said film forming step and said irradiation step are alternately repeated without exposing said substrate to the air, to accumulate said semiconductor thin film.~~

~~3. A process for producing a thin film semiconductor device comprising~~

a film forming step of forming a semiconductor thin film comprising an amorphous material or a polycrystalline material having a relatively small particle diameter on a substrate;

an irradiation step of irradiating said semiconductor thin film with an energy beam to convert said amorphous material or said polycrystalline material having a relatively small particle diameter to a polycrystalline material having a relatively large particle diameter; and

a forming step of integrating and forming a thin film transistor in a prescribed region by using said semiconductor thin film thus converted to said polycrystalline material as an active layer,

wherein said irradiation step is bulk irradiation conducted in such a manner that a cross sectional shape of said energy beam is adjusted with respect to said region to crystallize said region at a time by a single shot irradiation, so that characteristics of said thin film transistor are made uniform.

4. A process for producing a thin film semiconductor device as claimed in claim 3, wherein said forming step comprises integrating and forming a thin film transistor to produce a thin film semiconductor device for a display panel comprising a pixel array and a scanner circuit; and said irradiation step comprises irradiating a region, in which said scanner circuit is to be integrated and formed at a time.

5. A process for producing a thin film semiconductor device as claimed in claim 3, wherein in said irradiation step, a threshold value characteristics of a thin film transistor contained in said region is made uniform by said bulk irradiation.

6. A process for producing a thin film semiconductor device as claimed in claim 5, wherein said forming step comprises forming at least one circuit selected from an operational amplifier circuit, an analog/digital conversion circuit, a digital/analog conversion circuit, a level shifter circuit, a memory circuit, and a microprocessor circuit in said region.

7. A laser irradiation apparatus, by which a semiconductor thin film comprising an amorphous material or a polycrystalline material having a relatively small particle diameter formed on a substrate is irradiated with laser light to convert into a polycrystalline material having a relatively large particle diameter,

said laser irradiation apparatus comprising

a laser light source emitting laser light having a prescribed cross sectional shape;

shaping means of shaping said cross sectional shape of said laser light to adjust to a prescribed region; and

irradiating means of irradiating a semiconductor thin film with said shaped laser light to uniformly crystallize in said region.

8. A laser irradiation apparatus, by which a semiconductor thin film comprising an amorphous material or a polycrystalline material having a relatively small particle diameter formed on a substrate capable of carrying information for processing is irradiated with laser light to convert into a polycrystalline material having a relatively large particle diameter,

at least one condition selected from a cross sectional shape, an irradiating position, an energy amount, an energy distribution and a moving direction of said laser light is capable of being adjusted by reading said information.

9. A laser irradiation apparatus as claimed in claim 8, wherein said information is read by recognizing a pattern formed on a surface of said substrate.

10. A laser irradiation apparatus as claimed in claim 8, wherein said information is read by detecting a code written in said substrate.

Sub. A1

11. A thin film semiconductor device comprising a semiconductor thin film, a gate insulating film accumulated on one surface thereof, and a gate electrode accumulated on said semiconductor thin film through said gate insulating thin film,

wherein said semiconductor thin film is formed by forming amorphous silicon or polycrystalline silicon having a relatively small particle diameter on a substrate, and irradiating said substrate with an energy beam to convert to polycrystalline silicon having a relatively large particle diameter,

Sub. A' cont.

a thin film transistor is integrated and formed in a prescribed region by using said semiconductor thin film thus converted to polycrystalline silicon as an active layer, and

a cross sectional shape of said energy beam is adjusted with respect to said region to irradiate said region at a time by a single shot irradiation, so that characteristics of said thin film transistor is made uniform.

12. A display device comprising a pair of substrate adhered to each other with a prescribed gap, and an electrooptical substance maintained in said gap, one of said substrate comprises a counter electrode, the other substrate comprises a pixel electrode and a thin film transistor driving said pixel electrode, and said thin film transistor comprises a semiconductor thin film and a gate electrode accumulated on one surface of said semiconductor thin film through a gate insulating film,

wherein said semiconductor thin film is formed by forming amorphous silicon or polycrystalline silicon having a relatively small particle diameter on said other substrate, and

irradiating said other substrate with an energy beam to convert to polycrystalline silicon having a relatively large particle diameter,

Sub. A' cont'd.

a thin film transistor is integrated and formed in a prescribed region by using said semiconductor thin film thus converted to polycrystalline silicon as an active layer, and

a cross sectional shape of said energy beam is adjusted with respect to said region to irradiate said region at a time by a single shot irradiation, so that characteristics of said thin film transistor is made uniform.

13. A process for producing a thin film semiconductor device comprising

a film forming step of forming a semiconductor thin film comprising an amorphous material or a polycrystalline material having a relatively small particle diameter on a substrate, on which plural units are formed;

an irradiation step of intermittently irradiating said semiconductor thin film with an energy beam moving with respect to said substrate, to convert said amorphous material or said polycrystalline material having a relatively small particle diameter to a polycrystalline material having a relatively large particle diameter; and

a forming step of integrating and forming a thin film transistor by using said semiconductor thin film thus converted

to said polycrystalline material as an active layer, to form thin film semiconductor devices in said respective units,

wherein said irradiation step is bulk irradiation conducted in such a manner that a cross sectional shape of said energy beam is adjusted with respect to said unit to irradiate one or two or more units at a time by a single shot irradiation.

14. A laser irradiation apparatus, by which a semiconductor thin film comprising an amorphous material or a polycrystalline material having a relatively small particle diameter formed on a substrate, on which prescribed units are formed, is intermittently irradiated with laser light moving with respect said semiconductor thin film to convert into a polycrystalline material having a relatively large particle diameter,

said laser irradiation apparatus comprising

a laser light source intermittently emitting laser light;

an optical system for enlarging or reducing a cross sectional shape of said laser light to adjust to said units; and

shielding means for shielding a part other than said units from the laser light,

wherein irradiation is conducted by bulk irradiation of one or two or more units at a time by a single shot irradiation.

15. A laser irradiation apparatus as claimed in claim 14, wherein said apparatus further comprises moving means for

moving said substrate with respect to said laser light to make possible to irradiate all of said units with said laser light.

16. A laser irradiation apparatus as claimed in claim 15, wherein said apparatus further comprises detecting means for optically reading a positioning mark provided on said substrate, and controlling means for controlling said moving means corresponding said mark thus read.

17. A thin film semiconductor device comprising a semiconductor thin film, a gate insulating film accumulated on one surface thereof, and a gate electrode accumulated on said semiconductor thin film through said gate insulating thin film,

Sub. A2

wherein said semiconductor thin film is formed by forming amorphous silicon or polycrystalline silicon having a relatively small particle diameter on a substrate, on which plural units are formed, and intermittently irradiating said substrate with an energy beam moving with respect to said substrate, so as to convert to polycrystalline silicon having a relatively large particle diameter,

Sub. C

a cross sectional shape of said energy beam is adjusted with respect to said unit to irradiate one or two or more units at a time by a single shot irradiation, and

a thin film transistor is integrated and formed in said units thus subjected to irradiation at a time.

18. A display device comprising a pair of substrate adhered to each other with a prescribed gap, and an

electrooptical substance maintained in said gap, one of said substrate comprises a counter electrode, the other substrate comprises a pixel electrode and a thin film transistor driving said pixel electrode, and said thin film transistor comprises a semiconductor thin film and a gate electrode accumulated on one surface of said semiconductor thin film through a gate insulating film,

Sub. A2 cont'd.

wherein said semiconductor thin film is formed by forming amorphous silicon or polycrystalline silicon having a relatively small particle diameter on a substrate, on which plural units are formed, and intermittently irradiating said substrate with an energy beam moving with respect to said substrate, so as to convert to polycrystalline silicon having a relatively large particle diameter,

a cross sectional shape of said energy beam is adjusted with respect to said unit to irradiate one or two or more units at a time by a single shot irradiation, and

a thin film transistor is integrated and formed in said units thus subjected to irradiation at a time.

19. A process for producing a semiconductor thin film comprising

a film forming step of forming a semiconductor thin film comprising an amorphous material or a polycrystalline material having a relatively small particle diameter on a substrate; and

a laser annealing step of irradiating a prescribed region of said semiconductor thin film at a time with laser light having a prescribed cross sectional area to convert said amorphous material or said polycrystalline material having a relatively small particle diameter to a polycrystalline material having a relatively large particle diameter,

wherein said film forming step and said laser annealing step are alternately repeated without exposing said substrate to the air, so as to accumulate said semiconductor thin films.

20. A process for producing a semiconductor thin film as claimed in claim 19, wherein said laser annealing step comprises irradiating with laser light at a condition in that TE/(d·S) is from 0.01 to 1, wherein d (nm) represents a thickness of said semiconductor thin film having been formed, TE (J) represents total energy of said laser light, and S (cm^2) represents an area of a region irradiated with said laser light at a time.

21. A process for producing a semiconductor thin film as claimed in claim 19, wherein said laser annealing step is repeated with said laser light having such energy that is being increased along with the lapse of said steps.

22. A process for producing a semiconductor thin film as claimed in claim 19, wherein said film forming step is repeated to form a semiconductor thin film having such a

thickness that is being decreased along with the lapse of said steps.

23. An apparatus for producing a semiconductor thin film comprising

a film formation chamber where a semiconductor thin film comprising an amorphous material or a polycrystalline material having a relatively small particle diameter is formed on a substrate; and

a laser annealing chamber where a prescribed region of said semiconductor thin film is irradiated at a time with laser light having a prescribed cross sectional area to convert said amorphous material or said polycrystalline material having a relatively small particle diameter to a polycrystalline material having a relatively large particle diameter,

wherein said apparatus further comprises means for transporting said substrate back and forth between said film forming chamber and said laser annealing chamber without exposing said substrate to the air, so as to accumulate said semiconductor thin films by alternately repeating said film forming step and said laser annealing step.

24. An apparatus for producing a semiconductor thin film as claimed in claim 23, wherein said laser annealing chamber comprises irradiating with laser light at a condition in that TE/(d·S) is from 0.01 to 1, wherein d (nm) represents a thickness of said semiconductor thin film having been formed,

TE (J) represents total energy of said laser light, and S (cm^2) represents an area of a region irradiated with said laser light at a time.

25. An apparatus for producing a semiconductor thin film as claimed in claim 23, wherein said laser annealing chamber is repeated with said laser light having such energy that is being increased along with the lapse of said steps.

26. An apparatus for producing a semiconductor thin film as claimed in claim 23, wherein said film forming chamber is repeated to form a semiconductor thin film having such a thickness that is being decreased along with the lapse of said steps.

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27. A thin film transistor having a laminated structure comprising a semiconductor thin film, a gate insulating film accumulated on one surface thereof, and a gate electrode accumulated on said semiconductor thin film through said gate insulating thin film,

wherein said semiconductor thin film is formed by forming amorphous silicon or polycrystalline silicon having a relatively small particle diameter on a substrate, and irradiating a prescribed region of said substrate with laser light having a prescribed cross sectional shape to convert to polycrystalline silicon having a relatively large particle diameter at a time, and

said semiconductor thin films are accumulated by alternately repeating said film forming step and said irradiation step without exposing said substrate to the air.

Sub. A3 Cont'd.

28. A display device comprising a pair of substrate adhered to each other with a prescribed gap, and an electrooptical substance maintained in said gap, one of said substrate comprises a counter electrode, the other substrate comprises a pixel electrode and a thin film transistor driving said pixel electrode, and said thin film transistor comprises a semiconductor thin film and a gate electrode accumulated on one surface of said semiconductor thin film through a gate insulating film,

wherein said semiconductor thin film is formed by forming amorphous silicon or polycrystalline silicon having a relatively small particle diameter on a substrate, and irradiating a prescribed region of said substrate with laser light having a prescribed cross sectional shape to convert to polycrystalline silicon having a relatively large particle diameter at a time, and

said semiconductor thin films are accumulated by alternately repeating said film forming step and said irradiation step without exposing said substrate to the air.

29. A process for producing a semiconductor thin film comprising a film forming step of forming a non-single crystal semiconductor thin film on a surface of a substrate, and an

annealing step of irradiating said non-single crystal semiconductor thin film with laser light to convert to a polycrystalline material,

wherein said annealing step is conducted in such a manner that said semiconductor thin film is irradiated once or more with a pulse of laser light having a constant cross sectional area and an emission time width from upstand to downfall of 50 ns or more, so as to convert said semiconductor thin film contained in an irradiated area corresponding to said cross sectional area to a polycrystalline material at a time, and

an energy intensity of said laser light from upstand to downfall is controlled to apply a desired change.

30. A process for producing a semiconductor thin film as claimed in claim 29, wherein said annealing step has an inclined change in that an energy intensity at downfall is smaller than an energy intensity at upstand.

31. A process for producing a semiconductor thin film as claimed in claim 29, wherein said annealing step has an inclined change in that an energy intensity at downfall is larger than an energy intensity at upstand.

32. A process for producing a semiconductor thin film as claimed in claim 29, wherein in said annealing step, when an energy density of said laser light is controlled to apply a desired change, a changing width thereof is 300 mJ/cm^2 or less.

33. A process for producing a semiconductor thin film as claimed in claim 29, wherein said annealing step comprises irradiating a pulse of laser light having a cross sectional area of 100 cm^2 or more.

34. A laser irradiation apparatus for irradiating a semiconductor thin film comprising an amorphous material or a polycrystalline material having a relatively small particle diameter formed on a substrate with laser light to convert into a polycrystalline material having a relatively large particle diameter,

said laser irradiation apparatus comprising

a laser light source emitting a pulse of laser light having an emission time width from upstand to downfall of 50 ns or more;

shaping means for shaping a cross sectional area of said laser light to a prescribed shape;

irradiating means for irradiating said semiconductor thin film at least once with said pulse of laser light thus shaped, so as to convert said semiconductor thin film contained in an irradiated area corresponding to said cross sectional area to a polycrystalline material at a time; and

controlling means for controlling an energy intensity of said laser light from upstand to downfall to apply a desired change.

35. A laser irradiation apparatus as claimed in claim 34, wherein said controlling means has an inclined change in that an energy intensity at downfall is smaller than an energy intensity at upstand.

36. A laser irradiation apparatus as claimed in claim 34, wherein said controlling means has an inclined change in that an energy intensity at downfall is larger than an energy intensity at upstand.

37. A laser irradiation apparatus as claimed in claim 34, wherein in said controlling means, when an energy density of said laser light is controlled to apply a desired change, a changing width thereof is 300 mJ/cm^2 or less.

38. A laser irradiation apparatus as claimed in claim 34, wherein said shaping means comprises irradiating of said laser light having a cross sectional area of 100 cm^2 or more to a rectangular shape.

39. A thin film transistor having a laminated structure comprising a semiconductor thin film, a gate insulating film accumulated on one surface thereof, and a gate electrode accumulated on said semiconductor thin film through said gate insulating film,

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wherein said semiconductor thin film is formed by forming non-single crystal silicon on a substrate, and irradiating a prescribed region of said substrate once or more with a pulse of laser light having a constant cross sectional area and an

emission time width from upstand to downfall of 50 ns or more, so as to convert said non-single crystal silicon contained in an irradiated area corresponding to said cross sectional area to a polycrystalline silicon at a time, and

said polycrystalline silicon is modified by applying a desired change to said energy intensity of said laser light from upstand to downfall of said pulse.

Sub. A4 con't.

40. A display device comprising a pair of substrate adhered to each other with a prescribed gap, and an electrooptical substance maintained in said gap, one of said substrate comprises a counter electrode, the other substrate comprises a pixel electrode and a thin film transistor driving said pixel electrode, and said thin film transistor comprises a semiconductor thin film and a gate electrode accumulated on one surface of said semiconductor thin film through a gate insulating film,

wherein said semiconductor thin film is formed by forming non-single crystal silicon on said other substrate, and irradiating a prescribed region of said substrate once or more with a pulse of laser light having a constant cross sectional area and an emission time width from upstand to downfall of 50 ns or more, so as to convert said non-single crystal silicon contained in an irradiated area corresponding to said cross sectional area to a polycrystalline silicon at a time, and

Sub. A4 Cont'd.

said polycrystalline silicon is modified by applying a desired change to said energy intensity of said laser light from upstand to downfall of said pulse.

41. A process for producing a semiconductor thin film comprising a film forming step of forming a non-single crystal semiconductor thin film on a surface of a substrate; and an annealing step of irradiating said non-single crystal semiconductor thin film with laser light to convert said non-single crystal semiconductor thin film to a polycrystalline material,

wherein said annealing step is conducted in such a manner that said substrate is irradiated once or more with a pulse of laser light having an emission time width of 50 ns or more and a constant cross sectional area with maintaining said substrate in a non-oxidative atmosphere, so as to convert said semiconductor thin film contained in an irradiated area corresponding to said cross sectional area to a polycrystalline material at a time.

42. A process for producing a semiconductor thin film as claimed in claim 41, wherein said annealing step is conducted in such a manner that said substrate is irradiated with said laser light with maintaining said substrate in said non-oxidative atmosphere comprising vacuum.

43. A process for producing a semiconductor thin film as claimed in claim 41, wherein said annealing step is conducted

in such a manner that said substrate is irradiated with said laser light with maintaining said substrate in said non-oxidative atmosphere filled with an inert gas.

44. A process for producing a semiconductor thin film as claimed in claim 43, wherein said annealing step is conducted in such a manner that said substrate is irradiated with said laser light with maintaining said substrate in said non-oxidative atmosphere filled with an inert gas at an atmospheric pressure or in a pressurized inert gas.

45. A process for producing a semiconductor thin film as claimed in claim 41, wherein said annealing step comprises irradiating said substrate with a pulse of laser light having a cross sectional area of 5 cm^2 or more.

46. A process for producing a semiconductor thin film as claimed in claim 41, wherein said annealing step comprises irradiating said substrate with said laser light having an energy intensity controlled to a range of from 400 to 600 mJ/cm^2.

47. A laser irradiation apparatus for irradiating a semiconductor thin film comprising an amorphous material or a polycrystalline material having a relatively small diameter formed on a substrate with laser light to convert to a polycrystalline material having a relatively large particle diameter,

said laser irradiation apparatus comprising

a laser light source emitting a pulse of laser light having an emission time width of 50 ns or more;

shaping means for shaping a cross sectional area of the laser light to a prescribed shape;

maintaining means for maintaining said substrate previously having a semiconductor thin film in a non-oxidative atmosphere; and

an irradiating means for irradiating said substrate maintaining in said non-oxidative atmosphere once or more with said pulse of laser light thus shaped, so as to convert said semiconductor thin film contained in an irradiated region corresponding to said cross sectional area to a polycrystalline material at a time.

48. A laser irradiation apparatus as claimed in claim 47, wherein said maintaining means maintains said substrate in said non-oxidative atmosphere comprising vacuum.

49. A laser irradiation apparatus as claimed in claim 47, wherein said maintaining means maintains said substrate in said non-oxidative atmosphere filled with an inert gas.

50. A laser irradiation apparatus as claimed in claim 49, wherein said maintaining means maintains said substrate in said non-oxidative atmosphere filled with an inert gas at an atmospheric pressure or in a pressurized inert gas.

51. A laser irradiation apparatus as claimed in claim 47, wherein said shaping means shapes said pulse of laser light

to a rectangular shape having a cross sectional area of 5 cm^2 or more.

52. A laser irradiation apparatus as claimed in claim 47, wherein said irradiating means irradiates said substrate with said laser light having an energy intensity controlled to a range of from 400 to 600 mJ/cm^2.

53. A thin film transistor having a laminated structure comprising a semiconductor thin film, a gate insulating film accumulated on one surface thereof, and a gate electrode accumulated on said semiconductor thin film through said gate insulating film,

Sub. A5

wherein said semiconductor thin film is formed by forming non-single crystal silicon on a substrate, and irradiating a prescribed region of said substrate once or more with a pulse of laser light having a constant cross sectional area and an emission time width of 50 ns or more with maintaining said substrate in a non-oxidative atmosphere, so as to convert said non-single crystal silicon contained in an irradiated area corresponding to said cross sectional area to a polycrystalline silicon at a time.

54. A display device comprising a pair of substrate adhered to each other with a prescribed gap, and an electrooptical substance maintained in said gap, one of said substrate comprises a counter electrode, the other substrate comprises a pixel electrode and a thin film transistor driving

said pixel electrode, and said thin film transistor comprises a semiconductor thin film and a gate electrode accumulated on one surface of said semiconductor thin film through a gate insulating film,

Sub. A5 Con'd.

wherein said semiconductor thin film is formed by forming non-single crystal silicon on said other substrate, and irradiating a prescribed region of said substrate once or more with a pulse of laser light having a constant cross sectional area and an emission time width of 50 ns or more with maintaining said other substrate in a non-oxidative atmosphere, so as to convert said non-single crystal silicon contained in an irradiated area corresponding to said cross sectional area to a polycrystalline silicon at a time.

55. A process for producing a semiconductor thin film comprising a film forming step of forming a non-single crystal semiconductor thin film on a surface of a substrate; and an annealing step of irradiating said non-single crystal semiconductor thin film with laser light to convert said non-single crystal semiconductor thin film to a polycrystalline material,

wherein said annealing step is conducted in such a manner that said substrate is irradiated once or more with a pulse of laser light having an emission time width of 50 ns or more and a constant cross sectional area under conditions in that said substrate is uniformly heated, so as to convert said

semiconductor thin film contained in an irradiated area corresponding to said cross sectional area to a polycrystalline material at a time.

56. A process for producing a semiconductor thin film as claimed in claim 55, wherein said annealing step comprises irradiating said substrate with laser light with maintaining said substrate in a vacuum atmosphere under conditions in that said substrate is uniformly heated.

57. A process for producing a semiconductor thin film as claimed in claim 55, wherein said annealing step comprises irradiating said substrate with laser light with maintaining said substrate in an inert gas atmosphere under conditions in that said substrate is uniformly heated.

58. A laser irradiation apparatus for irradiating a semiconductor thin film comprising an amorphous material or a polycrystalline material having a relatively small diameter with laser light formed on a substrate with laser light to convert to a polycrystalline material having a relatively large particle diameter,

said laser irradiation apparatus comprising

a laser light source emitting a pulse of laser light having an emission time width of 50 ns or more;

shaping means for shaping a cross sectional area of said laser light to a constant shape;

heating means for uniformly heating said substrate previously having a semiconductor thin film; and

irradiating means for irradiating said heated substrate once or more with said pulse of laser light thus shaped, so as to convert said semiconductor thin film contained in an irradiated region corresponding to said cross sectional area to a polycrystalline material at a time.

59. A laser irradiation apparatus as claimed in claim 58, wherein said heating means uniformly heats said substrate comprising glass to a range of from 300 to 450°C.

60. A laser irradiation apparatus as claimed in claim 58, wherein said heating means comprises a heat source built in a stage carrying said substrate.

61. A laser irradiation apparatus as claimed in claim 58, wherein said heating means heats said substrate with maintaining said substrate in a vacuum atmosphere.

62. A laser irradiation apparatus as claimed in claim 58, wherein said heating means heats said substrate with maintaining said substrate in an inert gas atmosphere.

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63. A thin film transistor having a laminated structure comprising a semiconductor thin film, a gate insulating film accumulated on one surface thereof, and a gate electrode accumulated on said semiconductor thin film through said gate insulating film,

Sub. A6 Con'd.

wherein said semiconductor thin film is formed by forming non-single crystal silicon on a substrate, and irradiating a prescribed region of said substrate once or more with a pulse of laser light having a constant cross sectional area and an emission time width of 50 ns or more under conditions in that said substrate is uniformly heated, so as to convert said non-single crystal silicon contained in an irradiated area corresponding to said cross sectional area to a polycrystalline silicon at a time.

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64. A thin film transistor as claimed in claim 63, wherein said thin film transistor comprises a laminated structure comprising a semiconductor thin film, a gate insulating film accumulated on one surface thereof, and a gate electrode accumulated on said semiconductor thin film through said gate insulating film.

Sub 7 C

Sub. A7

65. A display device comprising a pair of substrate adhered to each other with a prescribed gap, and an electrooptical substance maintained in said gap, one of said substrate comprises a counter electrode, the other substrate comprises a pixel electrode and a thin film transistor driving said pixel electrode, and said thin film transistor comprises a semiconductor thin film and a gate electrode accumulated on one surface of said semiconductor thin film through a gate insulating film,

wherein said semiconductor thin film is formed by forming non-single crystal silicon on said other substrate, and irradiating a prescribed region of said substrate once or more with a pulse of laser light having a constant cross sectional area and an emission time width of 50 ns or more under conditions in that said other substrate is uniformly heated, so as to convert said non-single crystal silicon contained in an irradiated area corresponding to said cross sectional area to a polycrystalline silicon at a time.

Sub A7 Con'd.

66. A process for producing a semiconductor thin film comprising a film forming step of forming a non-single crystal semiconductor thin film on a surface of a substrate; and an annealing step of irradiating said non-single crystal semiconductor thin film with laser light to convert said non-single crystal semiconductor thin film to a polycrystalline material,

wherein said annealing step is conducted in such a manner that said substrate is irradiated once or more with a pulse of laser light having an emission time width of 50 ns or more and a constant cross sectional area under conditions in that said substrate is cooled to a temperature lower than room temperature, so as to convert said semiconductor thin film contained in an irradiated area corresponding to said cross sectional area to a polycrystalline material at a time.

67. A process for producing a semiconductor thin film as claimed in claim 66, wherein in said annealing step, cooling is conducted at a substrate temperature lower by 50°C or more than said substrate temperature increased by irradiation with laser light.

68. A process for producing a semiconductor thin film as claimed in claim 66, wherein in said annealing step, cooling is conducted at a substrate temperature lower by 100°C or more than said substrate temperature increased by irradiation with laser light.

69. A process for producing a semiconductor thin film as claimed in claim 66, wherein in said annealing step annealing step comprises irradiating said semiconductor thin film with a pulse of laser light having a cross sectional area of from 10 to 100 cm^2.

70. A laser irradiation apparatus for irradiating a semiconductor thin film comprising an amorphous material or a polycrystalline material having a relatively small diameter formed on a substrate with laser light to convert to a polycrystalline material having a relatively large particle diameter,

said laser irradiation apparatus comprising

a laser light source emitting a pulse of laser light having an emission time width of 50 ns or more;

shaping means for shaping a cross sectional area of the laser light to a constant cross sectional area;

cooling means for cooling said substrate previously having a semiconductor thin film to a temperature lower than room temperature; and

Sub C1

an irradiating means for irradiating said cooled substrate once or more with said pulse of laser light thus shaped, so as to convert said semiconductor thin film contained in an irradiated region corresponding to said cross sectional area to a polycrystalline material at a time.

71. A laser irradiation apparatus as claimed in claim 70, wherein said cooling means cools to a substrate temperature lower by 50°C or more than said substrate temperature increased by irradiation with laser light.

72. A laser irradiation apparatus as claimed in claim 70, wherein said cooling means cools to a substrate temperature lower by 50°C or more than said substrate temperature increased by irradiation with laser light.

Sub. A8

73. A thin film transistor having a laminated structure comprising a semiconductor thin film, a gate insulating film accumulated on one surface thereof, and a gate electrode accumulated on said semiconductor thin film through said gate insulating film,

wherein said semiconductor thin film is formed by forming non-single crystal silicon on a substrate, and irradiating a

prescribed region of said substrate once or more with a pulse of laser light having a constant cross sectional area and an emission time width of 50 ns or more under conditions in that said substrate is cooled to a temperature lower than room temperature, so as to convert said non-single crystal silicon contained in an irradiated area corresponding to said cross sectional area to a polycrystalline silicon at a time.

Sub. A8 cont.

Sub C1

74. A display device comprising a pair of substrate adhered to each other with a prescribed gap, and an electrooptical substance maintained in said gap, one of said substrate comprises a counter electrode, the other substrate comprises a pixel electrode and a thin film transistor driving said pixel electrode, and said thin film transistor comprises a semiconductor thin film and a gate electrode accumulated on one surface of said semiconductor thin film through a gate insulating film,

wherein said semiconductor thin film is formed by forming non-single crystal silicon on said other substrate, and irradiating a prescribed region of said substrate once or more with a pulse of laser light having a constant cross sectional area and an emission time width of 50 ns or more under conditions in that said other substrate is cooled to a temperature lower than room temperature, so as to convert said non-single crystal silicon contained in an irradiated area corresponding to said cross sectional area to a polycrystalline silicon at a time.